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# Systematic Approach to Acute Cardiovascular Emergencies

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Additional information is available at the end of the chapter

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## Abstract

Cardiovascular emergencies and symptoms are one of the most common reasons for patients' attendance in any emergency department (ED). Symptoms are either related to true cardiovascular problems or mimic cardiovascular problems. It becomes very difficult at times to differentiate between them. Many symptoms which mimic the cardiovascular problem may be present due to other systems' involvement. So, there may be an atypical presentation of cardiovascular emergencies or atypical presentation of other system problems presenting as cardiovascular diseases. Missing true cardiovascular emergencies can be a reason for mortality and morbidity cases which puts burden on healthcare services and affects physicians' morale. Here, in this chapter, we will discuss common cardiovascular emergencies and their presentations and approach to deal with them. We will also discuss differential diagnosis, when dealing with such conditions. We will also discuss the best diagnostic modalities and disposition plans which will ensure patient safety.

**Keywords:** cardiovascular emergencies, approach to common CVS symptoms in ED, approach to CVS emergencies

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## 1. Introduction

Cardiovascular emergencies are one of the most common and serious emergencies presenting to the emergency department. They are notorious in a sense that the signs and symptoms are seen in a huge spectrum of diseases, where some differentials are so benign that they do not require any further investigation. On the other hand, they may present with such vague symptoms that physicians may miss the diagnosis if they do not have a high index of suspicion. Here, in this chapter, we will discuss all the signs and symptoms which any patient with

a cardiovascular problem may present. I will also discuss the approach to deal with these symptoms and how to manage them and finally dispose them.

## 2. Common signs and symptoms in cardiovascular emergencies

The cardiovascular emergencies can present with typical or atypical signs and symptoms. Some patients have so minor complaints that they can be missed if physicians do not have a high index of suspicion. While examining a patient, it is important to have a wide range of differentials in mind. Emergency physicians should examine a patient to pick up signs or symptoms related to cardiovascular emergencies—complications directly or indirectly related to cardiovascular emergencies or signs and symptoms related to underlying diseases which manifest as acute cardiovascular problems at the time of presentation in the emergency department. Physicians with depth of medical knowledge, good skills of history taking and examination will less likely miss serious cardiovascular emergencies.

Following are the signs and symptoms which may indicate cardiovascular problems and need to be evaluated with a high index of suspicion in the emergency department.

### A. Typical cardiovascular symptomatology

1. Chest symptoms (chest pain, chest tightness or pressure-like symptoms, discomfort)
2. Breathlessness (orthopnea, paroxysmal nocturnal dyspnea, exertional breathlessness)
3. Palpitation
4. Sweating
5. Pedal edema or generalized edema

### B. Atypical symptomatology:

Diagnosis becomes challenging when patients present with atypical symptoms [1]:

1. Pain in the neck, jaw, throat or arm (ischemic pain)
2. Pain in abdomen (related to heart failure/liver congestion or ischemia)
3. Pain or numbness in the leg or cold extremities (related to poor circulation associated with vascular problems or poor cardiac output)
4. Dyspepsia
5. Light headedness or dizziness
6. Pain at the back (ischemia)
7. Fainting (Syncope) or near fainting
8. Fatigability and tiredness
9. Cardiac asthma (cough)

**C. Important signs of cardiovascular emergencies or problems**

1. Hypotension
2. Postural drop
3. Raised jugular venous pressure (JVP)
4. Cyanosis
5. Basal crepitation
6. Muffled/added heart sounds and murmurs
7. Pericardial rub
8. Decreased breath sound
9. Abdominal distension
10. Pedal edema
11. Splinter hemorrhages
12. Osler nodes

**D. Signs related to valvular heart diseases**

**a. Aortic regurgitation signs:**

1. Corrigan's pulse
2. De Musset's sign
3. Quincke's sign
4. Traube's sign
5. Duroziez's sign
6. Landolfi's sign
7. Becker's sign
8. Müller's sign

**b. Mitral stenosis:**

1. Heart failure symptoms, such as dyspnea on exertion, orthopnea and paroxysmal nocturnal dyspnea (PND)
2. Thromboembolism in later stages when the left atrial volume is increased
3. Palpitations
4. Hemoptysis
5. Chest pain

- c. Mitral regurgitation:
  - 1. Dyspnea
  - 2. Fatigue
  - 3. Orthopnea
  - 4. Pulmonary edema
- d. Infective endocarditis: signs and symptoms of infective endocarditis
- E. Signs related to complications of cardiovascular diseases (infective endocarditis)
  - 1. Seizures
  - 2. Stroke
  - 3. Pulmonary embolism
  - 4. Cor pulmonale
  - 5. Kidney damage
  - 6. Enlarged spleen
  - 7. Dissociated abscesses
  - 8. Tender spleen
  - 9. Janeway lesions
  - 10. Petechiae
  - 11. Osler nodes
  - 12. Hematuria

### **3. Systematic approach to cardiovascular symptoms**

#### **3.1. Approach to chest pain in the emergency department**

Chest pain is one of the most common symptoms which patients present with in the emergency department. The wide range of differentials and the severity of the consequences of missing serious causes of chest pain and fear of litigation put pressure on physicians to request a wide range of investigations to discharge the patient safely. The lack of confidence in decision-making and unnecessary referrals to other subspecialties are the reasons for delayed disposition, thus adding to the length of stay in the emergency department. In this section we will discuss in detail the common differentials of chest pain in the emergency department and how to investigate and dispose each patient timely and appropriately.

### 3.1.1. Differential diagnosis of atraumatic chest pain

Chest pain is a symptom which could be due to a very serious underlying condition that may be life threatening, or it may be due to very benign condition [2, 3]. Here is the list of conditions which needs to be considered in patients presenting with chest pain [2] **Table 1**.

### 3.1.2. History taking

The most important key to diagnose serious medical conditions in the emergency department is the accurate history and examination. While taking history, all the important question

Critical diagnosis	Emergent diagnosis
CVS:	CVS:
1. Acute MI	1. Unstable Angina
2. Acute Coronary Ischemia	2. Coronary Spasm
3. Aortic Dissection	3. Prinzmetal Angina
4. Cardiac Tamponade	4. Cocaine induced Pericarditis/Myocarditis
Pulmonary:	Respiratory:
1. Tension Pneumothorax	1. Mediastinitis
2. Pulmonary Embolism	2. Pneumothorax
Gastrointestinal:	Gastrointestinal:
1. Boerhaave (Esophageal Rupture)	1. Mallory Weiss
	2. Cholecystitis
	3. Pancreatitis
Non-emergent diagnosis	
Cardiac:	
1. Mitral Valve Prolapse	
2. Valvular Heart Diseases	
3. Aortic stenosis	
4. Hypertrophic cardiomyopathy	
Pulmonary:	
1. Pneumonia	
2. Pleurisy	
3. Tumor	
4. Pneumomediastinum	
Gastrointestinal:	
1. Esophageal spasm	
2. Esophageal Reflux	
3. Peptic ulcer disease	
4. Biliary Colic	
/Musculoskeletal:	
1. Muscle strain	
2. Rib Fracture	
3. Arthritis	
4. Costochondritis	
5. Tumor	
6. Non-Specific pain	
Neurologic:	
1. Spinal Root Compression	
2. Thoracic outlet	
3. Herpes Zoster	
4. Post herpetic neuralgia	

**Table 1.** Differential diagnosis of atraumatic chest pain.

should be asked which may help in ruling in or out the important differentials. The important questions to be asked while taking history are:

1. **Onset of pain:** Sudden onset of severe chest pain may indicate conditions like pneumothorax or aortic dissection. Pain associated with meals may indicate gastrointestinal cause. Cardiac chest pain may occur with exertion or even at rest without any physical activity.
2. **Character of pain:** The character of pain may give some clue about the underlying condition although a large number of patients with ischemic cause may have non-specific chest pain which may mimic other conditions like dyspepsia. Patients with burning type of chest pain or indigestion may give the impression of gastrointestinal cause but it may be due to cardiac ischemia explaining visceral etiology of pain. Patients with ischemic cardiac disease may have crushing or squeezing chest pain or pressure-like symptoms. Aortic dissection may induce tearing chest pain which migrate from front to back or back to front. Sharp stabbing pain which may increase with breathing may be due to either musculoskeletal cause or pulmonary cause.
3. **Severity of pain:** The severity of pain may not be linked to severity of underlying diagnosis. Sometimes, peptic ulcer disease may present with a severe type of chest pain mimicking cardiac pain. Patients with ischemic heart disease may present with very vague or mild symptoms. Patients with dissection of aorta may present with severe tearing chest pain.
4. **Duration of pain:** Pain which is for few days with no change in character is unlikely to be due to cardiac ischemia. Anginal pain is usually less than 30 min in duration whereas pain of myocardial infarction (MI) stays more than 30 min. Pain which stays from few seconds to minutes is unlikely to be cardiac in origin.
5. **Associated symptoms:** Cardiac chest pain may have associated symptoms like breathlessness, cough, palpitation, sweating and loss of energy and asthenia. Pulmonary embolism or pneumothorax may also present with chest pain, breathlessness and sweating, thus mimicking ischemic cardiac pain. Patients may have a fainting episode or syncope and near syncope before the onset of symptoms. Patients may present with some secondary conditions like road traffic accident or altered sensorium due to the underlying cardiac insult. Nausea and vomiting may be seen with cardiovascular and gastrointestinal causes of chest pain.
6. **Radiation of pain:** Pain in the chest which radiates to the back may indicate aortic dissection or gastrointestinal causes like perforation, pancreatitis and posterior peptic ulcer. Cardiac chest pain may radiate to the neck, jaw and arm.
7. **Location of pain:** Pain which is localized and involves a small area is unlikely related to any visceral cause and is due to somatic nerves. Pain involving periphery of the chest is usually due to a pulmonary cause whereas cardiac chest pain is usually in the lower chest or upper abdomen. Gastrointestinal conditions may have the similar area of distribution as cardiac. Cardiac chest pain though is usually in the left precordial area but may also be in right-sided chest.
8. **Aggravating or relieving factors:** Pain at exertion indicates ischemic coronary syndrome whereas pain at rest indicates conditions like dyspepsia and neuropathic pain.



Musculoskeletal and pulmonary causes of chest pain aggravate with breathing and chest movements.

9. Risk factors: Patients with risk factors like diabetes mellitus, hypertension, smoking, hyperlipidemia, a strong family history of ischemic heart disease, ethnicity and age above 40 years, but patients with no risk factors are not immune to ischemic cardiac disease. The presence of risk factors is the indicator to be more vigilant and careful in discharging patients.
10. Young patients with ischemic character of chest pain: Young patients when having ischemic type of chest pain present a clue to look at the conditions like vasculitis and connective tissue disorders and substance and drug abuse like cocaine.

### 3.1.3. Examination

Detailed physical examination can give some clue to diagnose the underlying cause. Examination includes general physical examination, abnormalities in vital signs and presence of other signs which may be related to cardiac pathology or complication of ischemic heart disease or an underlying medical condition which is the reason to present as ischemic heart disease. These signs help in the diagnosis of underlying cardiac or other problems. Following are some important findings which must be looked at to diagnose the cause of chest pain.

1. Tachycardia: Presence of tachycardia indicates serious underlying medical conditions. Following are the conditions which cause tachycardia:

MI or coronary ischemia	Cholecystitis
Myocarditis/pericarditis	Diabetic ketoacidosis
Aortic dissection	Pulmonary embolism
Tension pneumothorax	Esophageal rupture
	Mallory Weiss

2. Bradycardia: Bradycardia is a complication of ischemic cardiac problems and is related to heart blocks. It may be seen in

Acute MI	Coronary ischemia	Unstable angina
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3. Hypertension: Hypertension may be seen as a stress response to acute cardiac ischemia or it may be the reason to present as acute heart failure or chest pain. Hypertension is seen in conditions like

Acute MI	Coronary ischemia	Aortic dissection
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4. Hypotension: Hypotension may be seen as a complication of cardiovascular emergencies. Patient may also present with low BP in condition which mimic cardiovascular emergencies



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Severe massive MI  
Heart failure  
Aortic dissection  
Myocarditis/pericarditis

Coronary ischemia  
Tension pneumothorax  
PE  
Esophageal rupture

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5. Hypoxemia: Hypoxemia may be seen in acute cardiovascular emergencies or conditions mimicking cardiac emergencies

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Heart failure/pulmonary edema  
Pneumothorax

PE  
Massive effusion

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6. Fever: Presence of fever with other serious symptoms like chest pain or breathlessness usually indicates medical emergencies related to other systems. Following are the conditions where fever may be present with other complaints

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Myocarditis/pericarditis  
Mediastinitis  
PE

Cholecystitis  
Esophageal rupture

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7. Sweating or diaphoresis: Sweating is an autonomic response to many medical emergencies. It is non-specific symptom or sign but may indicate seriousness of the underlying problem so it must be given importance when present. Following are the differentials which must be considered in a patient presenting with diaphoresis with chest pain or breathlessness.

- Acute MI
- Aortic dissection
- Coronary ischemia
- Unstable angina
- PE
- Cholecystitis
- Peptic ulcer
- Esophageal rupture

8. Respiratory distress: Respiratory distress is one of the indications of serious underlying medical problems. Patients who are tachypneic or distressed at presentation in the emergency department should be prioritized and treated. Following are the serious underlying conditions which present with respiratory distress.

- a. Acute MI
- b. PE

- c. Heart failure/pulmonary edema
- d. Tension pneumothorax/simple pneumothorax

9. Cardiovascular system (CVS) examination: When examining CVS, all the differential diagnosis must be kept in mind to elaborate the findings related to these conditions. Each condition may have specific findings which help in reaching diagnosis. The following cardiovascular conditions or conditions which mimic cardiovascular problems must be kept in mind when examining CVS.

BP difference in upper and lower extremity: Aortic dissection.

Narrow pulse pressure: Pericarditis with effusion.

New murmur: Seen in

- a. Acute MI
- b. Coronary ischemia
- c. Aortic dissection

#### **Gallop (S3/S4)**

- a. Acute MI
- b. Coronary ischemia

**Pericardial rub:** Pericarditis.

#### **Raised JVP:**

- a. Acute MI
- b. Coronary ischemia
- c. Pericarditis
- d. Tension pneumothorax
- e. PE

10. Respiratory examination: Respiratory system examination is one of the most important examinations in the cardiovascular emergencies as many pulmonary pathologies mimic serious cardiovascular problems, and sometimes differentiating them from cardiac problems is not that easy and needs sophisticated investigations like CT scan in contrast with V/Q scans. Following are the important pulmonary signs which indicate respiratory pathologies mimicking cardiovascular emergencies.

Unilateral decreased or absent breath sounds:

- Tension pneumothorax/pneumothorax

Pleural rub: Pulmonary embolism.

Crepitation:

- a. Acute myocardial infarction
- b. Coronary ischemia
- c. Unstable angina
- d. Pneumonia

Subcutaneous emphysema:

- a. Tension pneumothorax
- b. Simple pneumothorax
- c. Esophageal rupture
- d. Mediastinitis

Wheezes

- Asthma
- Cardiac asthma

11. Abdominal examination: Many abdominal conditions may mimic cardiovascular emergencies. Sometimes it is difficult to exclude them on the basis of history and examination alone. When examining the abdomen, following signs need to be looked at which indicate abdominal conditions mimicking cardiovascular emergencies.

**Epigastric tenderness:**

- Esophageal rupture
- Mallory Weiss syndrome
- Cholecystitis
- Pancreatitis

Left upper-quadrant tenderness: Pancreatitis.

Right upper-quadrant tenderness: Cholecystitis.

12. Neurologic examination: Cardiovascular emergencies may have a very atypical presentation when it's a true diagnostic dilemma in the emergency department. Following are the atypical neurological presentations of underlying serious cardiovascular emergencies

Focal neurological findings: Aortic dissection.

**Stroke:**

- Acute MI
- Coronary ischemia

- Aortic dissection
- Coronary spasm

### 13. Findings of DVT in extremity: PE

#### 3.1.4. Investigations

Patients presenting with chest pain should be investigated for serious underlying medical causes as delay in diagnosis may be catastrophic in many conditions. Following are the important tests needed to diagnose important medical emergencies.

**Positive cardiac markers:** They give information about myocardial infarction.

#### ECG

**ECG:** ECG is the most important bed-side investigations which should be ordered for any patient who comes to the emergency department with chest pain and pain involving lower chest, upper abdomen, neck, arm and jaw in a risky age group. It should be done in the earliest possible (within 10 min of arrival to the emergency department). Delaying in getting ECG done will delay the diagnosis which may result in serious consequences in conditions like acute MI.

Following are the conditions which may have findings on ECG

- Acute MI
- Coronary ischemia
- Coronary spasm
- Aortic dissection
- PE
- Pericarditis/myocarditis
- Arrhythmia

**CXR:** Chest X-Ray is one of the simplest diagnostic modalities which may give important clues to patients with chest pain and or breathlessness. It may give information about heart, lungs and mediastinum and abdominal and diaphragmatic problems. It is easily available in hospitals and one should have a low threshold in requesting for them if the cause of chest pain and breathlessness is not clear or justified. Following are the conditions which can be seen on CXR.

- Pneumothorax
- Tension pneumothorax
- Pleural effusion (lung and heart pathologies, esophageal rupture)
- Cardiomegaly (CCF, pericardial effusion)
- Pneumomediastinum (esophageal rupture, mediastinitis)

- Widening of mediastinum (aortic dissection)
- Lung masses (malignancies)
- Diaphragmatic problems (paralysis, hernia)

**ABG:** Arterial blood gases help in diagnosing the cardiac and lung pathologies indirectly by indicating the CO, oxygen, HCO<sub>3</sub> levels, PH and A-a gradient. Hypoxemia and A-a gradient may indicate PE. ABG gives information about type 1 and type 2 respiratory failure as well.

**Echocardiography:** Echocardiography is one of the quickest and easily available modalities in many tertiary care centers where even the ER physicians are experts in using this modality and can get information about patient's conditions [4]. Echocardiography is now one of the most important diagnostic tools in modern emergency medicine practice. Following important information can be taken by using bed-side echo.

- Pericardial effusion
- Wall-motion abnormality
- RV strain
- Dilated right ventricle
- Ejection fraction
- Septal abnormality
- Hypertrophied ventricles and septum
- Valvular problems
- Aortic problems
- IVC
- Left ventricular outflow tract obstruction
- Cardiac masses and thrombi

**V/Q scan:** V/Q scans are helpful in places where CT scans are not widely available or where due to some reasons CT scans cannot be done or are harmful. V/Q scans help in diagnosing PE.

**Spiral CT:** Spiral CT helps in diagnosing pulmonary embolism but also gives information about other pulmonary conditions and pathologies which may be the reason for these symptoms.

**CT angiography:** Computed tomography angiography (CTA) uses an injection of iodine-rich contrast material and CT scan to help diagnose and evaluate blood vessel diseases or related conditions, such as aneurysms or blockage.

**Ultrasonography:** Ultrasound is a rapidly available important diagnostic tool in many tertiary care centers and is getting more popular in emergency medicine practice. Emergency medicine physicians can use this tool to get important information about many medical conditions and

thus can take timely decisions. Following information can be taken by using bed-side ultrasound.

- Pleural effusion and pericardial effusion
- Congestive hepatomegaly
- Inferior vena cava and hydration status
- Pneumothorax
- Pneumonias
- Cholelithiasis, cholecystitis and common bile duct

### *3.1.5. Management*

After taking proper history and doing a detailed examination, the differential diagnosis will be narrowed down. Use of appropriate investigation will help the emergency physician to reach to some conclusion. Serious conditions like tension pneumothorax, pulmonary embolism and acute coronary syndrome need quick attention and referrals to subspecialty for timely management. Each condition has its own management plan which will be discussed later in this chapter.

### *3.1.6. Disposition*

Timely patient disposition is the key to success. Patients presenting with acute coronary syndrome (ACS) and acute myocardial infarction should have timely referral to cardiology for possible early PCI. Patients with moderate to high risk of acute coronary syndrome should be admitted to cardiology care even if the initial labs are normal. Patients with low risk can be discharged with early follow up in the cardiology department. Normal ECG or absence of positive cardiac enzymes is not the criteria to discharge any patient with chest pain who falls in the category of moderate or high risk.

## **3.2. Approach to breathlessness in the emergency department**

Breathlessness is also one of the symptoms which has serious differential diagnosis, which, if not diagnosed and managed timely, can lead to grave consequences. Chest pain and breathlessness are the two serious symptoms which may be due to benign conditions and may be due to serious underlying problems which can lead to death from minutes to hours. Good medical knowledge, anticipation of problems, art of taking good medical history and doing detailed physical examination, choosing the right and appropriate investigation and timely and appropriate disposition help in saving life.

### *3.2.1. Differential diagnosis of breathlessness*

Breathlessness is one of the serious symptoms and should be given due care before we find out the reason for this symptom. Timely patients triaging and intervention is needed to deal with

this symptom. Breathlessness may be due to simple problems like anxiety and pregnancy, and it may be related to severe life-threatening conditions like tension pneumothorax. Here we will discuss important differential diagnosis of breathlessness based on the severity of underlying pathology (**Table 2**).

3.2.2. History taking

The most important key to diagnose serious medical conditions in the emergency department is proper history and examination. While taking history, all the important questions should be

Critical diagnosis	Emergent diagnosis
CVS: 1. Acute MI 2. Pulmonary Edema 3. Cardiac Tamponade Respiratory: 1. Tension Pneumothorax 2. Epiglottitis 3. Anaphylaxis 4. Ventilatory Failure 5. Airway Obstruction 6. PE 7. Flail Chest Metabolic/Endocrine: 1. Toxic Ingestion 2. DKA Neuromuscular: 1. CVA 2. Intracranial Insult 3. Organophosphate Poisoning Miscellaneous: 1. CO Poisoning 2. Acute Chest Syndrome	CVS: 1. Pericarditis 2. Myocarditis Respiratory: 1. Pneumothorax 2. Hemothorax 3. Asthma 4. Pneumonia 5. Aspiration 6. Cor Pulmonale Neuromuscular: 1. Multiple Sclerosis 2. Guillian Barre 3. Myasthenia Gravis 4. Tick Paralysis Increased Respiratory Effort: 1. Mechanical Interference 2. Hypotension 3. Bowel Obstruction 4. Renal Failure 5. Electrolyte Abnormalities 6. Metabolic Acidosis 7. Diaphragmatic Rupture 8. Anemia
<b>Non-emergent diagnosis:</b> Cardiac: Metabolic/Endocrine: 1. Congenital Heart Disease 1. Thyroid 2. Cardiomyopathy 2. Fever 3. Valvular Heart Disease Pulmonary: Neuromuscular: 1. Pleural Effusion 1. ALS 2. COPD 2. Polymyositis 3. Pneumonia 4. Malignancies Related to Respiratory Effort: 1. Pregnancy 5. Rib Fracture 2. Ascites 6. Panic attack 3. Obesity 7. Pneumonia 4. Hyperventilation Syndrome 8. Somatization Disorders	

**Table 2.** Differential diagnosis of breathlessness.



asked which may help in ruling in or out the important differentials. The onset of breathlessness and duration and severity of breathlessness give a clue about the nature of the underlying disorder and urgency to treat them. The important questions to be asked while taking the history of breathlessness are:

1. Onset of breathlessness: Breathlessness of sudden onset is usually serious and must be addressed immediately. Among the differentials of acute sudden onset breathlessness are pneumothorax and pulmonary embolism. Choking with foreign bodies should be considered in the extreme of ages as well. Dyspnea which is slowly progressive and becomes serious in few hours to days may be due to conditions like asthma, COPD exacerbation, pneumonia, congestive heart failure, malignancies, recurrent small emboli, pleural effusion and neuromuscular disorders.
2. Duration of breathlessness: Breathlessness of short duration includes acute conditions like asthma exacerbation, infections, allergies, foreign bodies, cardiac dysfunctions and arrhythmias, pulmonary embolism, psychogenic and inhalation of irritants. Chronic and progressive conditions include chronic lung diseases like interstitial lung diseases, chronic heart failure, chronic pleural effusion and chronic cardiac and pulmonary disorders.
3. Related to trauma: Breathlessness related to trauma points to some of the most serious conditions which may be life threatening if not managed early. These include pneumothorax, tension pneumothorax, pulmonary contusion, hemothorax, flail chest, diaphragmatic rupture, cardiac tamponade, pericardial effusion and neurologic injury.
4. Positional changes and aggravating and relieving factors: Patients complaining of orthopnea may be suffering from left-sided heart failure, COPD and asthma exacerbation and neuromuscular disorders affecting the diaphragm which lead to splinting. Paroxysmal nocturnal dyspnea may be due to left-sided heart failure and COPD. Exertional dyspnea may be due to left-sided heart failure, COPD and restrictive and obstructive heart and lung diseases and conditions with abdominal loading. Conditions with abdominal loading include ascites, obesity and pregnancy.
5. Breathlessness with other associated symptoms: Other symptoms like fever, cough, chest pain, palpitation, sweating, weakness and paresthesia, swelling of feet and abdominal distension must be looked for. It helps in differentiating it from underlying cardiac problems or infective pathologies or neuromuscular disorders.

### 3.2.3. Examination

After a detailed history, thorough physical examination helps in finding the underlying cause of breathlessness. The examination includes vital signs, general appearance and detailed physical examination including systemic examinations like CVS, central nervous system (CNS), peripheral nervous system and respiratory system.

1. Tachypnea: Presence of tachypnea may indicate serious underlying medical conditions. Following are the conditions which cause tachypnea:

- Pulmonary edema
  - Pneumonia
  - Pneumothorax
  - Fever
  - Psychogenic
  - Ascites
  - Metabolic causes like diabetic ketoacidosis
  - Endocrine disorders
  - Infectious causes
  - Obstructive and restrictive respiratory and cardiac causes
  - Trauma leading to mechanical issues
  - Toxins
2. Hypopnea: It can be seen in respiratory depression due to neurologic causes or from toxins.
- Intracranial insult
  - Drugs and toxins
3. Tachycardia:
- PE
  - Drugs/toxins
  - Infections
  - Tension pneumothorax
  - Tamponade
  - Trauma
  - Lung contusion
  - Hypoxia-causing conditions
  - Acidosis and metabolic disorders
  - Myocarditis
  - Electrolyte and endocrine disorders
4. Hypotension
- Tension pneumothorax
  - Cardiac tamponade

5. Fever

- Infective conditions like pneumonia
- Myocarditis
- Malignancies

6. General appearance

- Pregnancy: PE
- Obesity: Hypoventilation, PE, sleep apnea
- Cachexia, weight loss: malignancy, chronic diseases like HIV
- Barrel chest: COPD
- Sniffing position: epiglottitis
- Tripod positioning: Severe COPD/asthma
- Bruises/crepitation/subcutaneous emphysema on chest: Flail chest, rib fracture, hemopneumothorax, lung contusion

7. Skin, nails and hands

- Wasting of hands: Pancoast tumor
- Tremors: CO<sub>2</sub> retention
- Tobacco stain: COPD, malignancy, infection
- Clubbing: Malignancy, shunts (intracardiac), pulmonary vascular anomalies, chronic hypoxia

8. Neck

- Stridor: Upper airway edema/infection, foreign body, traumatic injury, anaphylaxis
- JVD: Tension pneumothorax, tamponade, CHF, volume overload, thoracic outlet syndrome, COPD/asthma exacerbation, PE

9. Respiratory

- Wheeze: CHF, anaphylaxis, bronchospasm
- Rales: heart failure, pneumonia, PE
- Hemoptysis: Malignancy, mitral stenosis, infection, CHF, bleeding disorders
- Rub: Pleurisy
- Cheyne-stokes breathing: Intracranial insult
- Subcutaneous emphysema: Pneumothorax, tracheobronchial disruption

**10. Cardiac**

- Murmur/S3, S4 Gallop, S2 Accentuation: PE
- Muffled heart sound: Tamponade

**11. Neurologic**

- Focal deficit: Stroke, ICH
- Neuromuscular disease
- Diffuse weakness: Metabolic/electrolyte abnormalities (Ca, Mg, PO<sub>4</sub>), anemia
- Hyporeflexia: Hypermagnesemia
- Ascending weakness: Guillian Barre syndrome
- Myasthenia Gravis
- ALS

**12. Extremities**

- DVT
- Edema of legs due to CHF

**3.2.4. Investigation**

Patients presenting with chest pain should be investigated for serious underlying medical causes as delay in diagnosis may be catastrophic in many conditions. Following are the important tests needed to diagnose important medical emergencies.

**CXR:** Chest X-Ray is one of the simplest diagnostic modalities which may give important clues in patients with chest pain and or breathlessness. It may give information about heart, lungs and mediastinum and abdominal and diaphragmatic problems. It is easily available in hospitals and one should have a low threshold in requesting them if the cause of chest pain and breathlessness is not clear or justified. Following are the conditions which can be seen on CXR.

**ABG:** Look for A-a gradient for PE, hypoxia and hypercapnia.

**Positive cardiac markers:** Myocardial infarction leading to heart failure and presenting with breathlessness can be detected by positive cardiac markers.

**VQ Scan:** To differentiate PE from other causes.

**CT Scan:** It helps in identifying pulmonary and mediastinal and intra-abdominal causes and differentiating it from cardiac.

**ProBNP:** It helps in identifying congestive cardiac failure and complications of MI.

**D-Dimer:** It gives a clue about PE and negative D-Dimer helps in ruling out PE.

**Doppler:** It is a modality to look for the source of PE. Sometimes, finding DVT gives indirect information about the cause of breathlessness.

**Ultrasound:** Look for important Causes of breathlessness and differentiate it from cardiac causes. US may help in detecting or giving a clue about PE, pneumothorax, pleural effusion, pericardial effusion, pneumonia and aortic dissection.

**ECHO:** It helps in identifying cardiac problems like ejection fraction, fluid overload, aortic dissection, IVC status, wall-motion abnormality, RV strain pattern, pericardial effusion, features of PE and features of CCF.

**ECG:** ECG is the most important investigation to diagnose the cardiac causes of breathlessness.

- MI/ACS leading to pulmonary edema
- PE: dysrhythmias, right-heart strain
- Pericarditis/myocarditis: heart failure
- Arrhythmias

### 3.2.5. Management

Serious cardiac emergencies presenting as breathlessness like pulmonary edema, MI, PE and cardiac tamponade should be diagnosed immediately for timely management. The management of individual emergency is discussed further in the chapter.

### 3.2.6. Disposition

All serious medical emergencies are admitted to the medical ward or in ICU depending on the severity of problem. The individual disposition of each medical diagnosis is discussed further in the chapter.

## 3.3. Approach to palpitation in the emergency department

Cardiovascular emergencies may present with palpitation in the emergency department. Palpitation is a symptom which could be the manifestation of serious cardiovascular underlying problems. The underlying cause of palpitation may be either ischemic heart disease, metabolic and endocrine disorders, drugs, malignancies, inflammatory and infiltrative disorders, connective tissue disorders and environmental factors like electrocution. Any condition which affects conduction across myocardium may lead to irregular or abnormally fast or slow conduction manifesting as palpitation. On taking an ECG, one may find either very fast or slow rhythm which may be regular or irregular. The other abnormalities which may be seen on the ECG are short PR, prolonged QT, short QT, broad QRS, narrow QRS, abnormalities of P waves and blocks.

### 3.3.1. Differential diagnosis of palpitation

- Narrow complex tachycardia (regular or irregular)

AV node independent:

1. Sinus tachycardia
2. Atrial tachycardia (unifocal/multifocal)
3. Atrial fibrillation
4. Atrial flutter

AV-node dependent:

1. AV node re-entry tachycardia
2. AV re-entry tachycardia
3. Junctional tachycardia

- Broad complex tachycardia

1. Ventricular tachycardia
2. SVT with aberrant conduction

- Bradycardia

1. Heart tissue damage related to aging
2. Tissue damage due to ischemic heart disease
3. Congenital heart diseases
4. Myocarditis
5. Heart surgery
6. Malignancy
7. Inflammatory and infiltratory diseases
8. Metabolic and endocrine disorders
9. Radiations
10. Toxins, drugs and chemicals

### 3.3.2. Approach to palpitation

Whenever a patient complains of palpitation, the priority is to look for if the patient is stable or unstable. Immediately, vital signs of patients need to be recorded and the general condition of the patient is looked for. Patients with abnormal vital signs need to be taken to the monitored bed for further management. Patients who are stable hemodynamically can be treated by

medication whereas hemodynamically unstable patients require synchronized cardioversion [5]. Patients should be taken to the monitored bed and the IV line is maintained and investigations are sent to look for reversible causes which can be corrected.

### **3.4. Approach to syncope and fainting episode in the emergency department**

Cardiovascular emergencies may present as syncope, pre-syncope and fainting episode in the emergency department [4, 6]. Syncope is defined as a sudden transient loss of consciousness with a loss of postural tone. Any condition which affects cerebral perfusion (cardiac output, systemic vascular resistance, blood volume, regional vascular resistance) can lead to pre-syncope or syncope.

Pre-syncope or syncope may be caused by cardiovascular or CNS conditions. Here are the differential diagnoses of cardiovascular emergencies presenting as syncope:

#### *3.4.1. Differential diagnosis of cardiovascular causes of syncope*

- Cardiovascular diseases:
  1. MI
  2. Aortic dissection
  3. Cardiomyopathy
- Outflow obstruction:
  1. Valvular stenosis
  2. HOCM
  3. Atrial Myxoma
  4. PE
  5. Pulmonary hypertension
  6. Cardiac tamponade
  7. Congenital heart disease
- Reduced cardiac output:
  1. Tachycardia
    - I. SVT
    - II. Ventricular tachycardia
    - III. VF
    - IV. WPW
    - V. Torsade de Pointes



## 2. Bradycardia

- I. Sinus node disease
- II. Heart block (second and third degree)
- III. Prolonged QT
- IV. Pace maker malfunction
- V. ICD malfunction

## 3. Other cardiovascular diseases

- I. MI
- II. Aortic dissection
- III. Cardiomyopathy

### 3.4.2. History taking

History taking is the most important in diagnosing the patients presenting with syncope. There are wide differentials of syncope which range from very benign medical conditions like vasovagal attacks to most serious emergencies like aortic dissection or acute MI. History taking helps in narrowing down the differentials to a few in the list and then by detailed examination and suitable investigations physicians may reach to diagnosis or may be comfortable in discharging the patient to appropriate facilities for further management. The important information required in history taking include:

- Presence of chest pain
- Breathlessness
- Cough
- Palpitation
- Onset of symptom
- Pre-syncope symptoms
- Underlying medical conditions and comorbidities
- Use of medication
- Straining factors
- H/O previous such episodes
- Associated symptoms like seizure, loss of consciousness, weakness
- Emotional instability
- Toxins and drugs

### 3.4.3. Examination

Detailed physical examination is required to reach to diagnosis. The examination includes all the important systems which are included in the differential diagnosis of syncope.

- CNS examination:
- Respiratory system examination:

### 3.4.4. Investigation

The emergency physicians must choose important investigations to diagnoses serious underlying medical problems for timely management. Delay in the diagnosis of critical conditions may lead to serious consequences. Following are the important investigations needed in emergency department to diagnose cardiovascular emergencies presenting as syncope.

- ECG: Arrhythmias, ischemic heart diseases, cardiomyopathies
- Cardiac enzymes: Myocardial infarction
- Echocardiogram: Cardiac outflow obstruction, tamponade, aortic dissection, PE, valvular diseases with complications.

### 3.4.5. Management

Underlying cardiovascular problem needs to be treated once diagnosed. Management of individual emergencies is discussed further in the chapter.

## 4. Quick simple diagnostic and bed-side modalities to rapidly differentiate serious underlying medical emergencies

Patients presenting in the emergency department with chest pain, breathlessness, palpitation or sweating or with pre-syncope or syncope may have a wide range of differentials as a cause. Some of the conditions may be very serious and of grave outcomes if not managed immediately. Emergency physicians can use some important skills, tools and diagnostic tests to pick very serious underlying conditions which are the causes of these presentations. Timely management and disposition of these conditions may impact the overall outcome and prognosis. Here we will mention few tests and investigations which will help in differentiating the cause of cardiovascular symptoms.

### a. ECG

1. Ischemic heart disease
2. Cardiomyopathies
3. Blocks

4. Metabolic/electrolyte abnormalities
5. Arrhythmias

**b. Bed-side Ultrasound:**

1. Pneumothorax
2. Pneumonia
3. PE
4. Pleural effusion

**c. Bed-side Echo**

1. Wall-motion abnormality
2. Pericardial effusion/tamponade
3. PE
4. Aortic dissection
5. Valvular heart disease
6. Ventricular thickening
7. Ejection fraction
8. Myxoma/thrombus
9. Cardiac outflow obstruction

**d. X-Ray:**

1. Cardiomegaly
2. CCF/pulmonary edema
3. Pneumonia
4. Wide mediastinum
5. Pleural effusion
6. Pneumothorax
7. Lung mass
8. Diaphragmatic hernia

**e. Cardiac enzymes:** Acute MI

**f. Pro-BNP:** Acute heart failure

**g. ABG:** PE

**h. D-Dimer:** PE

## 5. Management of important cardiac emergencies in the ED

### 5.1. Acute coronary syndrome

Acute coronary syndrome includes a spectrum of clinical presentations which range from unstable angina to non-ST elevation MI and ST elevation MI. They can be differentiated on the basis of history, ECG changes and blood investigations. The management started should be according to the diagnosis.

#### 5.1.1. Spectrum of ACS

**Unstable angina:** It is referred to as pre-infarction angina or pre-occlusive syndrome. It is a warning sign of infarction.

**Myocardial infarction:** It is defined as cell death and necrosis. Below mentioned are the criteria satisfying the diagnosis of acute, evolving or recent MI.

1. Rise and fall of cardiac markers with
  - a. Symptoms of ischemia
  - b. ECG changes (either Q waves or changes consistent with ischemia like ST or T wave changes)
  - c. Coronary artery interventions
2. Pathological findings of acute MI

#### 5.1.2. Diagnosis

Diagnosis is done based on the history and physical examination and finally after diagnostic testing. The diagnostic testing includes ECG, chest X-Ray, serum cardiac markers, echocardiography, scintigraphy and CT angiography depending on the requirement and the availability.

ECG findings of MI:

#### 5.1.3. Management

The management goal is early revascularization and reperfusion using either fibrinolysis or primary angioplasty. In places where PCI is available, quick cardiologist consultation and activation of PCI code are needed so that the cardiologist is involved to decide which pathway to follow. Delay in getting PCI does not justify avoiding thrombolysis. If, for any reason, expected time for PCI is more than 90 min, then thrombolysis is the choice of treatment. Medical management is divided into two categories:

##### 5.1.3.1. Pharmacologic intervention

Oxygen should be administered when blood oxygen saturation is 90% or if the patient is in respiratory distress. In patients whose ischemic symptoms are not relieved by nitrates and

beta-blockers, opiate administration is reasonable while waiting for immediate coronary angiography, with the caveat that morphine may slow down the intestinal absorption of oral platelet inhibitors.

- **Nitroglycerine:** It is a coronary vasodilator and reduces myocardial pre-load and after load.
- **Pain management:** If the patient is in severe pain and not responding to NTG and beta-blockers.
- **Beta-blockers:** Early administration of beta-blockers should be avoided in these patients if the ventricular function is unknown and should not be administered in patients with symptoms possibly related to coronary vasospasm or cocaine use, as they might favor spasm by leaving alpha-mediated vasoconstriction unopposed by beta-mediated vasodilation.
- **Calcium channel blockers (CCBs):** CCBs are recommended for ischemic symptoms when beta-blockers are not successful, are contraindicated or cause unacceptable side effects. Long-acting CCBs and nitrates are recommended for patients with coronary artery spasm. They can be used for rate control in patients with SVT when beta blockers are not tolerable.
- **ACE inhibitors:** ACE inhibitors should be started and continued indefinitely in all patients with a left ventricular ejection fraction (LVEF) below 40% and in those with hypertension, diabetes mellitus or stable chronic kidney disease (CKD), unless contraindicated.
- **Antiplatelet:** Antiplatelet therapy reduces progression to acute infarction in patients with non-AMI ACS patients. Aspirin or GP11b/111a inhibitors may be used. Antiplatelet treatment reduces mortality.
- **Anticoagulation:** Administer anticoagulation, in addition to antiplatelet therapy, for all patients, irrespective of the initial treatment strategy. Treatment options include the following (all Class I):

**Subcutaneous(SC)** enoxaparin for the duration of hospitalization or until PCI is performed (level of evidence: A);

**Bivalirudin** until diagnostic angiography or PCI is performed in patients with early invasive strategy only (level of evidence: B);

**SC fondaparinux** for the duration of hospitalization or until PCI is performed (level of evidence: B);

**IV unfractionated heparin** (UFH) for 48 h or until PCI is performed (level of evidence: B).

#### 5.1.3.2. Reperfusion therapy

Reperfusion therapy, either by using thrombolytics or primary PCI, increases the opportunity to salvage ischemic myocardium. Fibrinolytic therapy improves coronary flow, limits infarct size and improves survival.

## 5.2. Heart failure

It is defined as the pathophysiologic state in which the heart is not capable of pumping sufficient supply of blood to meet the body requirements or else requires elevated ventricular filling pressures to accomplish this goal.

### 5.2.1. Pathophysiology of acute pulmonary edema

Cardiogenic pulmonary edema is due to increased capillary hydrostatic pressure secondary to acute ischemia or infarction, cardiomyopathy, valvular heart disease or hypertensive emergencies. Non-cardiogenic pulmonary edema occurs due to alteration in the permeability of pulmonary capillary membrane.

### 5.2.2. Compensatory mechanisms

The compensatory mechanisms secondary to heart failure include increase in stroke volume in response to increased pre-load, increased systemic vascular resistance and cardiac hypertrophy.

### 5.2.3. Treatment of heart failure

- stabilization of patient and resuscitation
- identify the underlying and precipitating cause and treat it
- control the symptoms and acute congestive state by reducing the cardiac work load (reducing pre-and after load), controlling excessive salt and water retention and improving cardiac contractility.
- Acute pulmonary edema with adequate perfusion:
  - nitrates
  - morphine
  - loop diuretics
  - nitroprusside
  - noninvasive or invasive ventilation [3, 7]
- Acute pulmonary edema in hypotensive patients
  - vasopressors and inotropes to maintain coronary perfusion
  - manage hypotension due to cardiogenic shock or due to volume depletion (identified by cardiac index and pulmonary artery outflow pressure)
  - judicious fluid challenge if low PAOP (<15 mm Hg)
  - IABP

- Emergency revascularization if ischemic cardiogenic shock
- Treatment of chronic heart failure:
  - Manage hypertension
  - Reverse remodeling by beta-blockers, ACE-I, aldosterone antagonists, ARB
  - Vasodilator therapy (ACE-I, ARB, Nitrates)
  - Diuretics
  - Cautious use of calcium blockers for hypertension, angina and dysrhythmia management
  - Beta-blocker therapy: Carvedilol may be effective agent in chronic HF
  - Digoxin

### 5.3. Hypertensive emergencies

In the Emergency Department hypertension presents as one of the four varieties:

1. Hypertensive emergency or crisis with acute end organ ischemia
2. Hypertensive urgency: Patients with poorly controlled hypertension
3. Mild hypertension
4. Transient hypertension which is related to anxiety or complaint

Only hypertension crisis requires treatment in the emergency department within 90 min of their presentation. Patients presenting with hypertensive emergencies will have markedly elevated BP and evidence of acute dysfunction in the cardiovascular, neurologic or renal system. Following are the conditions defined as hypertensive crisis:

1. Accelerated or malignant hypertension:
  - Hypertensive encephalopathy
  - Microangiopathic hemolytic anemia
  - Acute renal failure
2. Aortic dissection
3. Eclampsia/pre-eclampsia
4. Severe hypertension in the setting of:
  - Myocardial ischemia
  - LVF
  - Uncontrolled hemorrhage



- Systemic reperfusion therapy for stroke or MI
- Postoperative state

Drugs of choice in treatment of hypertensive emergencies: Crack Cast (**Table 3**)

#### 5.4. Dysrhythmias

Dysrhythmias present in the emergency department as chest pain, breathlessness, palpitation, sweating, pre-syncope, syncope and thromboembolic complications [8]. Managing dysrhythmias is very challenging in the emergency department. Timely intervention saves life. The first challenge is to diagnose the type of arrhythmias and categorize them as narrow complex or broad complex tachycardias or brady cardiac. The next step in management is to categorize them as stable or unstable. The type of management depends on the stability of patient as well as emergency physicians' expertise in managing them.

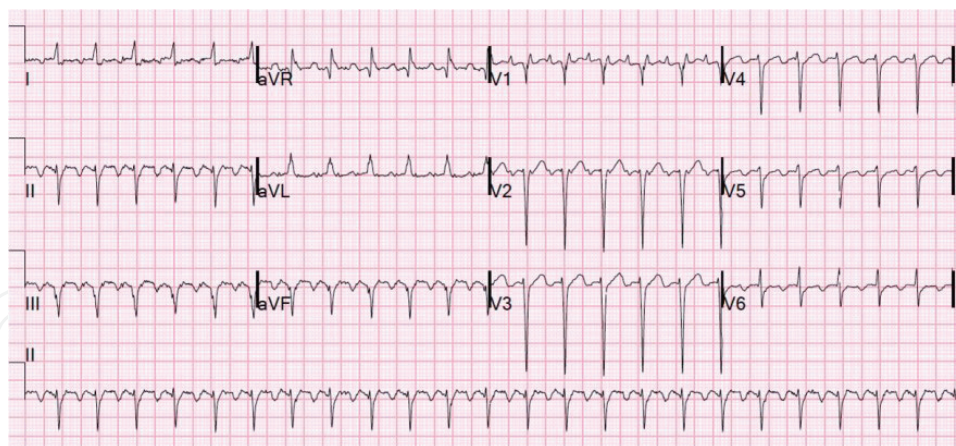
Diagnosis: 12 Lead ECG (see **Images 1, 2, 3, 4** for NCT and WCT)

a. Symptoms and signs of unstable patients in the emergency department includes:

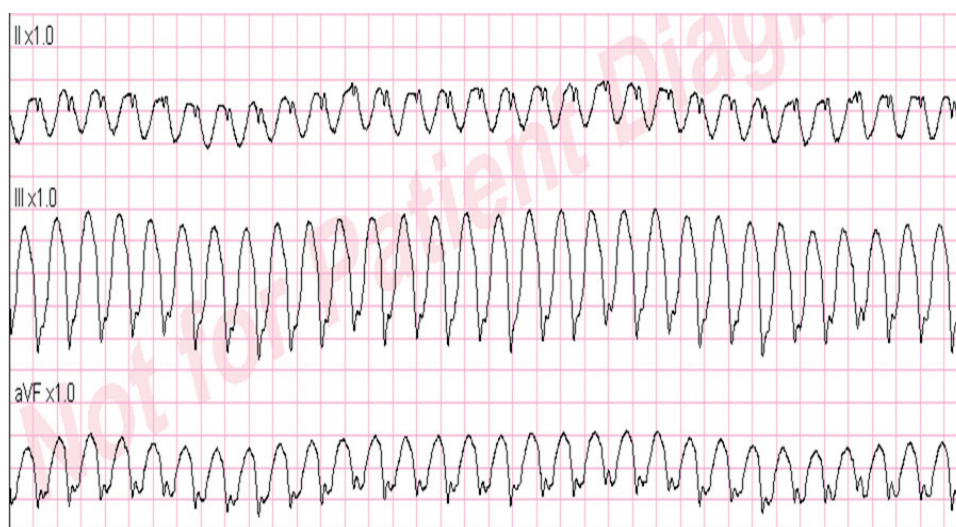
- Hypotension and or features of hypo-perfusion
- Chest pain suggesting myocardial ischemia
- Dyspnea or pulmonary edema
- Altered sensorium (agitation to coma)

Emergencies	Drug of choice	Alternatives
Hypertensive encephalopathy	Nicardipine Labetalol	Esmolol Enalaprilat
Intracranial Hemorrhage	Nicardipine Labetalol	Esmolol
Acute Pulmonary Edema	Nitroglycerine Furosemide Enalaprilat	Nicardipine Sodium Nitroprusside
Aortic Dissection	Esmolol and Sodium Nitroprusside Labetalol	Esmolol and Nicardipine Diltiazem, Verapamil
Ischemic Stroke	Nicardipine Labetalol	Esmolol Enalaprilat
Acute Kidney Injury	Fenoldapam Nicardipine, Clevidipine	Labetalol Sodium Nitroprusside
Preeclampsia/eclampsia	Hydralazine Labetalol	Nicardipine
Sympathetic Crisis	Phentolamine Nitroglycerine	Fenoldapam Clevidipine Nicardipine Sodium nitroprusside

**Table 3.** Management of hypertensive emergencies (Crack Cast).



**Image 1.** Narrow complex tachycardia: Courtesy Dr. smith ECG blog.



**Image 2.** Wide complex tachycardia (courtesy Dr smith blog).

- b.** Management of stable patients: Management of stable patients requires proper assessment and evaluation by detailed history and examination, ECG and then treatment depending on the type of rhythm, whether it's narrow complex or broad complex tachycardias. The treatment options are some maneuvers like vagal or valsalva and medications like adenosine, amiodarone, procainamide, verapamil and diltiazem. Narrow complex tachycardias are treated with drugs which slow AV nodal conduction like class 11 agents (beta-blockers) or class 1 V agents (calcium blockers) and adenosine or Class 1A (procainamide) and 1C (flecainide) drugs which are useful in converting narrow complex tachycardias to a sinus rhythm. See **Table 4** for treatment of NCT and WCT
- c.** Management of unstable patients: Unstable patients are managed more aggressively. Again, treatment options depend on whether it's narrow complex tachycardias or wide complex tachycardias and an emergency physician's expertise with the drugs and synchronized cardioversion.



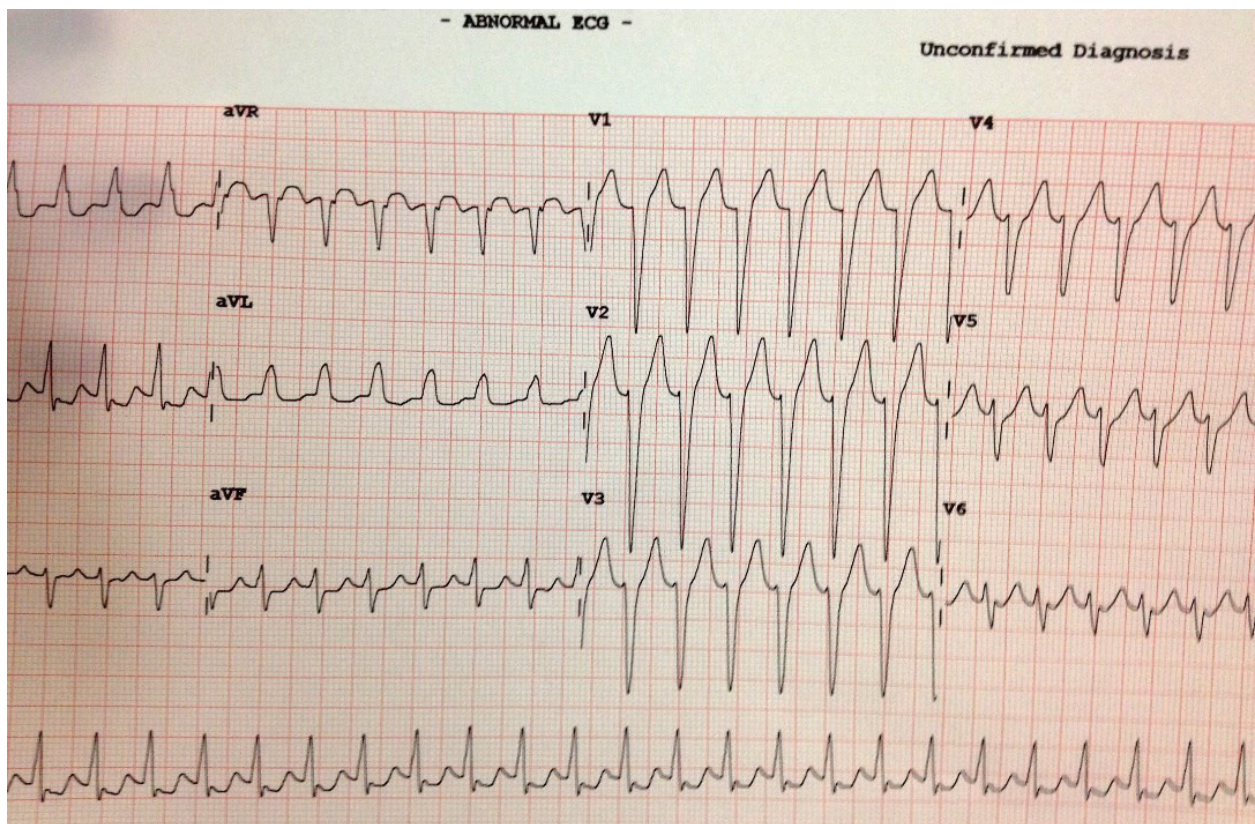


Image 3. SVT with aberrancy: Courtesy the blunt dissection.

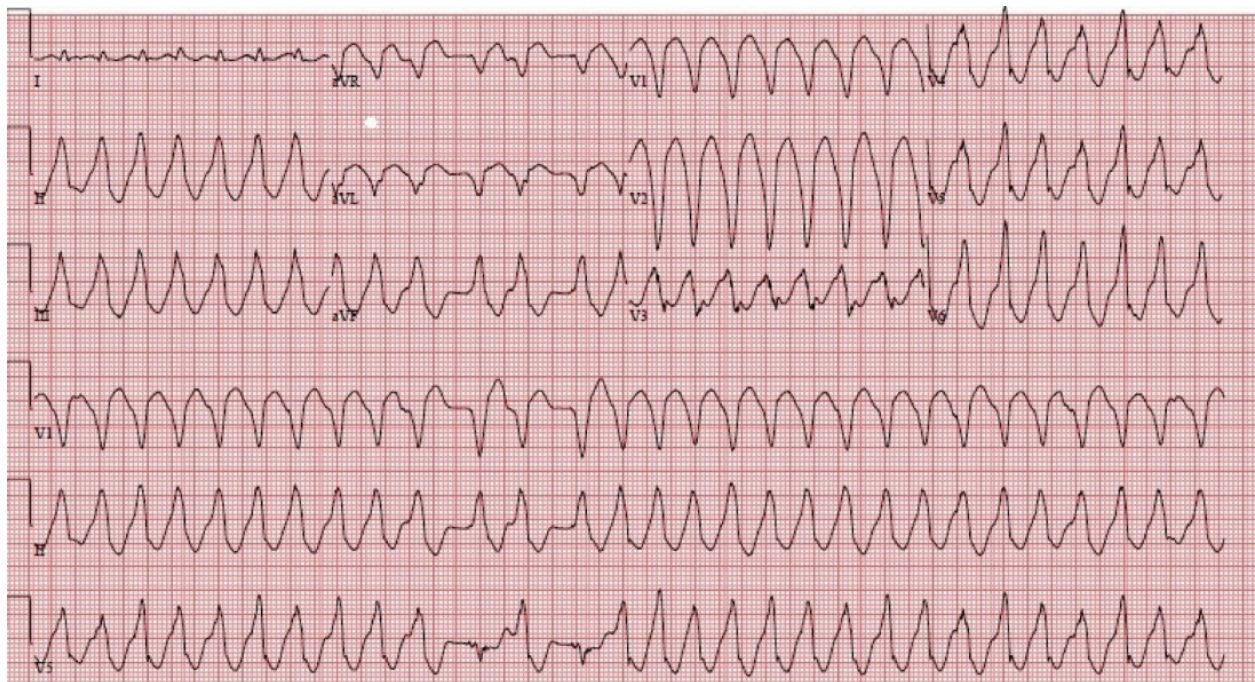


Image 4. Polymorphic V-Tac.

Type of Rhythm	Management Options	
Narrow complex	Atrial Fibrillation	<b>Pharmacologic cardioversion:</b> <ol style="list-style-type: none"><li>1. Procainamide (1A) or</li><li>2. Propafenone (1C) or</li><li>3. Flecainide (1C) or</li><li>4. Amiodarone (111) or</li><li>5. Ibutilide (111)</li></ol> <b>Rate Control:</b> <ol style="list-style-type: none"><li>1. A calcium blocker (Verapamil or diltiazem) may be used before type 1A agent</li><li>2. Beta Blockers</li></ol> <b>Anticoagulation:</b> anticoagulation in ED is needed depending on whether AF is new or chronic. <b>Electrical Cardioversion:</b> (50–100 J)
	SVT (AV nodal)	Vagal Maneuvers Pharmacologic Treatment: <ol style="list-style-type: none"><li>1. Adenosine</li><li>2. Calcium Blockers</li><li>3. Beta Blockers</li></ol> Electrical Cardioversion: (50-100 J)
	Atrial Flutter	<b>Pharmacologic:</b> <ol style="list-style-type: none"><li>a. <b>Rate Control:</b></li><li>b. Beta Blockers</li><li>c. Calcium Blockers</li><li>d. <b>Pharmacologic Cardioversion</b></li><li>e. Procainamide (1A)</li><li>f. Ibutilide (111)</li><li>g. Amiodarone (111)</li><li>h. <b>Electrical Cardioversion:</b> (25-50 J)</li></ol>
Wide Complex	V-Tach (stable)	Monomorphic: <ol style="list-style-type: none"><li>1. Treat underlying cause</li><li>2. Amiodarone</li><li>3. Procainamide</li><li>4. Lidocaine</li><li>5. Magnesium SO<sub>4</sub></li></ol> Polymorphic with Torsade de Pointes <ol style="list-style-type: none"><li>1. Treat Underlying Causes</li><li>2. IV MgSO<sub>4</sub></li><li>3. Beta-Adrenergic Infusion</li><li>4. Amiodarone</li><li>5. Overdrive Pacing</li></ol>
	SVT with Aberrancy	Atrial Fibrillation with aberrancy: <ol style="list-style-type: none"><li>a. Avoid: calcium Blockers Beta Blockers Digoxin</li><li>a. Use: Amiodarone Procainamide</li><li>a. Electrical Cardioversion 50-100 J (increase by 50–100 if no response till 360 J)</li><li>b. If Unstable: Treat as V Tac</li></ol>
	V-Tac (Pulseless)	Treat as Ventricular Fibrillation

Table 4. Treatment of Arrhythmias.



## 5.5. Aortic dissection

Aortic dissection is one of the most serious cardiovascular emergencies, presenting in ER, mimicking cardiac ischemia [9]. Failure to diagnose is catastrophe for the patient and may lead to death. Thrombolysis is contraindicated. Wrongly diagnosing them as cardiac ischemia and treating as MI may kill the patient.

- a. Types: Type A involves ascending aorta; Type B does not involve ascending aorta (Stanford classification)
- b. Presentation:
  - Chest pain/back pain (interscapular)
  - Syncope
  - Neurologic symptoms like weakness or change in mental status
- c. Physical examination:
  - Severe hypertension
  - Aortic regurgitation findings on auscultation
  - Discrepancy in BP and pulse deficits between limbs
  - Findings of stroke
  - Ischemic paraparesis or ischemic peripheral neuropathy (dissection of anterior spinal artery)
  - Acute inferior or posterior MI (RCA dissection)
- d. Diagnostic tests:
  - ECG: LVH, MI, ischemia, non-specific ST-T changes
  - CXR: Normal or widened mediastinum, calcium sign, double density aorta, obliteration of aortic knob, displaced NG-Tube
  - Echocardiography: Transthoracic echo is an insensitive tool but TEE is 98% sensitive and 95% specific. It is operator dependent.
  - Helical CT: It's a reliable test for diagnosis. It is almost 100% sensitive and 98% specific.
- e. Management: Medical management is needed in Type B, whereas type A requires surgical intervention.
  - Pain management
  - Blood pressure management: The goal is to reduce blood pressure and to decrease the rate of rise of arterial pulse. The target BP is 100/60 and heart rate of less than 60/m.

- Use beta-blockers with vasodilators to avoid tachycardia. Esmolol is used to control heart rate. Labetalol can be used. Sodium nitroprusside is used as a vasodilator. Nitroglycerin can be used as a vasodilator but needs beta-blocker in conjunction.
- Consultation with thoracic surgery for possible intervention in type A dissection.

5.6. Pulmonary embolism

Pulmonary embolism is the result of clot dislodgement which formed hours, days or weeks earlier in the deep veins and traveled through the venous system to traverse the right-sided heart, finally lodging in the pulmonary vasculatures.

5.6.1. Risk factors

The risk factors for pulmonary embolism are:

- Hypercoagulability like inherited thrombophilia, acquired thrombophilia, carcinomas, estrogen, pregnancy/postpartum
- Inflammation (connective tissue disorders, trauma, surgery, smoking)
- Vascular stasis (limb or generalized immobility)

5.6.2. Signs and symptoms:

Chest Pain	Pulse >100.
Breathlessness	Pulse oximeter reading <95%.
Syncope	Unilateral leg or arm swelling.
Hemoptysis	Signs of right heart failure

5.6.3. Diagnosis:

**ECG:** ECG may show S1, Q3, T3, non-specific ST-T changes, RV strain pattern, sinus tachycardia, pulmonary Hypertension changes (T inversion in V1-V4), incomplete or complete RBBB.

**CXR:** It may help in ruling out other causes of chest pain or breathlessness. Features of pulmonary infarction may indicate underlying PE (Hamptons Hump). Rarely an oligemic lung is seen.

**Echocardiography:** It helps in identifying features of right ventricular strain and right ventricular dilatation (indirect evidence of PE).

**D-Dimer:** It is used as a screening test. Negative D-Dimer is more helpful than positive D-Dimer which occurs in many other medical conditions as well.

**CTPA:** It's a gold standard to diagnose or rule out PE.

Doppler Ultrasound can be used to look for the primary source of thrombus when CTPA or V/Q scan is absolutely contraindicated or is considered a high-risk procedure.

**V/Q Scan:** It is used when CTPA is either contraindicated or not possible to perform.

#### *5.6.4. Management:*

- **Anticoagulation:** Anticoagulation with IV Heparin (bolus then infusion), fractionated heparin (Enoxaparin) or the Factor Xa inhibitor (Fondaparinux) is the current standard treatment for patients presenting with PE.
- **Thrombolytic therapy:** This is used in patients who present with severe symptoms, with features of massive PE who are not responding to standard treatment and are unstable and or go into cardiac arrest (PEA/asystole). Patients who show evidence of massive PE can be given thrombolytics provided they do not have contraindications of thrombolysis.
- **IVC filters:** These can be used in patients who have recurrent PE even on treatment.

## **6. Conclusion**

Cardiovascular emergencies present as most challenging emergencies in the emergency department. Presence of atypical signs and symptoms and presentations resembling many other benign medical conditions make it very challenging to timely diagnose them few times. Choosing inappropriate or unnecessary investigations will delay the disposition of the patient which may lead to a busy emergency department. It may lead to prolonged length of stay, delay in diagnosing serious emergencies and discharging patients inappropriately resulting in mortality or morbidity cases. This will compromise the credibility of the department. Taking proper history with systematic and symptomatic approach and doing a detailed examination and choosing the right investigations will reduce the length of stay of patient and on the other hand will help the physician in avoiding inappropriate discharges or referrals to subspecialty. Sound medical knowledge and awareness of differential diagnosis help in avoiding delayed patient disposition.

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